ESO 1045

ANNUAL COSTS OF PRODUCING SLOW GROWING EVERGREENS (TAXUS) DIFFERENTIATED BY SIZE OF FIRM IN OHIO

By

Harold H. Kneen, Reed D. Taylor, David E. Hahn, Elton M. Smith*

Department of Agricultural Economics
and Rural Sociology
The Ohio State University
Columbus, Ohio 43210

*Graduate Student, Associate Professor and Professor Dept. of Agricultural Economics and Rural Sociology, and Professor, Dept. of Horticulture, respectively. Mr. Kneen is presently on the management staff at Studebaker Nurseries, Inc., New Carlisle, Ohio.

October 1, 1983

ABSTRACT

The objective of this study was to determine annual production costs for slow growing evergreens in containers in Ohio differentiated by size of firm. This objective was accomplished by synthesizing two model container nurseries using the conceptual framework of economic engineering. Once the nurseries were synthesized, growing space was divided into five equal parts with each part being assigned a plant group. In the small container nursery, slow growing evergreens were allocated 68,000 sq ft of growing space and 40,800 sq ft of polyhouse space. For the large nursery, the figures were 136,000 and 81,600 sq ft respectively. One specific species of slow growing evergreen, Taxus, was choosen for detailed analysis. In the space allocated, 20,085 12-15 inch salable Taxus could be produced annually in the small nursery and 40,165 in the large. Total annual costs per salable plant were $5.58 in the small nursery and $5.08 in the large. These costs were based on 1982 figures and assumed a 2-year growing cycle with production in 2-gallon containers.

INTRODUCTION

Slow growing evergreens, such as the various species of Buxus and Taxus, have long been planted for hedges, foundation plantings and other locations where low maintenance is desirable. These plants have traditionally been grown in the field, however, new technological developments are now making it economically feasible to grown them in containers. These plants will probably in the future become as important to container operations as they have traditionally been in the field.

The specific objective of this study was to determine annual production costs for slow growing evergreens in containers in Ohio differentiated by size of firm. This information should aid Ohio nurserymen in their decisions regarding which plants to grow and in what quantities.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model. They were synthesized based on the Columbus, Ohio area. The complete synthesis included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with the purchase of plant liners and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs (4).

Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1982. The basic goals in synthesizing the production facilities were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and keep future expansion possible. See Taylor et. al. (4) for a detailed analylis on the physical plant, production system, and capital and production budgets*. Kneen et. al. (1) provides a rather precise summary of capital requirements for establishing container nurseries in ohio.

The production system chosen for this analysis essentially consists of utilizing husky three year old bareroot liners to produce a salable plant within two growing seasons. These 6-7" liners are transplanted directly into two gallon (8-1/2" x 8") copolymer containers during the month of May. Approximately 10% of the crop will be sold during the fall of the second growing season (approximately 18 months), 50% during March and April after the second growing season (approximately 22-23 months), and 10% during May after the second growing season (24 months). May is a period when clean-up sales are being made and new plants started. This production system saves transplanting as the plants are sold in the same containers in which they are started (two gallon).

A model facility was synthesized for both a small (340,000 sq ft of growing area) and a large (680,000 sq ft of growing area) container nursery. The nursery operations were assumed to produce a diverse line of nursery stock each having a two year production cycle. Commonly grown nursery

---

*A copy of this publication can be obtained by writing: Dr. Reed Taylor, The Ohio State University, 2120 Fyffe Road, Columbus, Ohio 43210.

stock was divided into five cultural groups. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate to input costs and cultural factors. For analytical purposes, it was assumed that each cultural group would occupy 20% of the growing area (i.e. small nursery = 68,000 sq ft per group; large nursery = 176,000 sq ft per group. Costs developed on slow growing evergreens (Taxus) therefore were based on the scale of the complete nursery, but analyzed on the basis of of percent of total space occupied. A report on spreading evergreens (Juniperus) using equivalent 1982 data was previously published (2) while companion studies in this publication report on spreading deciduous shrubs (Cotoneaster), upright deciduous shrubs (Viburnum) and broadleaf evergreens (Rhododendron).

For detailed analysis on slow growing evergreens, one specific plant type (Taxus) was choosen. While it is recognized that other slow growing evergreens would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the Taxus. Among others, the category of slow growing evergreens would include various species of Buxus. Some of their unique cultural characteristics would be pine bark medium and hardiness. They would require minimum overwinter protection. Thermal blankets within the polyhouses would not be required.

Costs were established for all factors of production including management and invested capital. In economic terms, costs associated with factors of production inputted by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested in land, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nurseries were first determined (1). Second, capital requirements per salable plant capacity by spacing and size of nursery were established (4). Third, annual fixed costs were calculated (see companion study entitled "Annual Fixed Costs of Operating Container Nurseries in Ohio Differentiated by Size of Firm and Species of Plant"). Fourth, annual variable costs were determined for each of the two sized nurseries (Tables 1 and 2). Fifth, summaries were made for annual fixed and variable costs for each of the plant groups according to size of nursery (Table 3). This allowed cost comparisons based on size of nursery.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. Analysis on a "cash" basis does not give a true economic picture of the cost of producing a plant as it does not take into account the time value of money from the time the plant is planted until it is harvested. The analyses do, however, give a true estimate of the annual cost per salable plant.

Total annual production costs consist of both fixed and variable factors. Fixed costs are primarily made up implicit costs such as depreciation on buildings and equipment, interest charges (both for borrowed and equity capital) and charges for management. Many nurserymen do not adequately consider fixed costs when computing costs of production. Fixed items are often considered as residual claimants on income. For example, management is compensated if all other factors of production have been accounted for. An noted previously, annual fixed costs are discussed in greater detail in a companion article.

Variable costs include all cost factors that vary with the quantity of plants being grown at one point in time. Variable costs are explicit, obvious and normally paid out yearly. Variable costs were subdivided into the following categories: materials, machinery and equipment, labor, and interest on operating capital (Tables 1 and 2). Details on specific variable cost items are included in the companion article on spreading deciduous shrubs (Cotoneaster).

After all cost factors were determined, they were summarized based upon cost per salable plant by size of nursery.

RESULTS AND DISCUSSION

Annual fixed, variable, and total production costs of producing slow growing evergreens (Taxus) in container nurseries in Ohio for 1982 are summarized in Table 3. In the small nursery, total annual costs were $112,053 or $5.58 per salable 12-15 inch plant. Fixed costs totaled $48,517 or $2.42 per plant and made up 43% of total costs. Based on a percentage of total costs, land and improvements made up 8%, buildings 9%, machinery and equipment 8%, general overhead 17%, and interest on general overhead, insurance, and taxes 1%. Variable costs totaled $63,536 or $3.16 per plant and made up 57% of total costs. Based on a percentage of total costs, materials made up 40%, machinery and equipment 3%, labor 10%, and interest on operating capital 4%.

In the large nursery, total annual costs were $204,128 or $5.08 per salable 12-15 inch plant. Fixed costs totaled $78,209 or $1.95 per plant and made up 38% of total costs. Based on percentage of total costs, land and improvements made up 8%, buildings 8%, machinery and equipment 6%, general overhead 15%, and interest on general overhead, insurance, and taxes 1%. Variable costs totaled $125,919 or $3.13 per plant and made up 62% of total costs. Based on a percentage of total costs, materials made up 44%, machinery and equipment 3%, labor 10%, and interest on operating capital 5%.

Total annual costs were 50 cents per plant more in the small nursery than in the large. Of this 50 cents, 47 cents or 94% were made up of fixed costs. On a per item basis, the large nursery's advantages were 2 cents on land and improvements, 11 cents on buildings, 12 cents on machinery and equipment, 20 cents on general overhead, and 2 cents on interest for general overhead, insurance and taxes. The 3 cents accounted for by variable costs were 2 cents on machinery and equipment and 1 cent on labor. Variable costs for materials, and interest on operating capital was the same for both sized nurseries.

In the nurseries analyzed, it cost 10% less to produce a 12-15 inch salable slow growing evergreen (Taxus) in the large nursery than in the small. While the overall reduction was 10%, it was 24% for fixed costs and only 1% for variable. Large-sized commercial container nurseries are able to make more efficient use of buildings, equipment, and machinery than small container nurseries.

Individual nurserymen might well experience or at least calculate costs considerably different than those depicted here. Most cost differences would probably be reflected in fixed rather than variable costs. Most fixed costs are implicit and their full impact may not be calculated by established nurserymen. Budgets presented assumed new facilites, machinery, and equipment. Most nurserymen have owned their land for many years and have used machinery and equipment. For the established nursery, budgeted fixed costs on land improvements, buildings, machinery and equipment presented here would reflect replacement rather than 'book values' of depreciated items. Presented fixed costs also placed a market value on management. Many nurserymen place little if any value on their own management when computing costs. Variable items, on the other hand are explicit, experienced at least yearly, and easily accounted for. Variable costs presented here would be typical for the industry in Ohio and should be rather consistent regardless of age and size of the nursery.

SUMMARY

Total annual costs per salable slow growing evergreen (Taxus) were $5.58 in the small nursery and $5.08 in the large. Fixed costs were $2.42 in the small nursery and $1.95 in the large for a differential of 47 cents per salable plant. Variable costs, on the other hand, were $3.16 in the small and $3.13 in the large for a differential of only 3 cents. These per plant costs assumed a 2-year growing cycle, production in 2-gallon containers and an average size of 12-15 inches per salable plant.

These figures demonstrated that variable costs on a salable plant basis, at least over the size range of nurseries analyzed, remain reasonably constant. The small nursery could purchase materials and other variable items almost as cheaply as could the large. Fixed costs in contrast changed significantly as size of nursery increased. This occurred because most of the fixed factors required to operate the small nursery such as management, buildings, and most machinery and equipment were also adequate to operate the large. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing the fixed cost per plant.

LITERATURE CITED

1. Kneen, Harold H., Reed D. Taylor, David E. Hahn, and Elton M. Smith. 1982. Capital Requirements for Establishing Container Nurseries in Ohio--1982. Ohio Agri. Res. and Dev. Ctr., Res. Circ. 274, Ornamental Plants--1983: A Summary of Research, pp. 3-8.

2. Kneen, Harold H., Reed D. Taylor, David E. Hahn, and Elton M. Smith. 1982. Production Costs of Operating Container Nurseries in Ohio--1982. Ohio Agri. Res. and Dev. Ctr., Res. Circ. 274, Ornamental Plants--1983: A Summary of Research, pp. 9-15.

3. Smith, Elton, M. and Sharon O. Treaster. 1982. Growth of Taxus cuspidata 'Thayeri' Produced in Containers. Ohio Agri. Res. and Dev. Crt., Res. Circ. 268, Ornamental Plants--1982: A Summary of Research, pp. 3-5.

4. Taylor, Reed E., Harold H. Kneen, David E. Hahn, and Elton M. Smith. 1983. Costs of Establishing and Operating Container Nurseries in U.S.D.A. Climatic Zone Six Differentiated by Size of Firm and Species of Plant. ESO 1026, Dept. of Agr. Econ. & Rur. Soc. The Ohio State Univ.

TABLE 1.--Annual Variable Costs (Dollars) for Slow Growing Evergreens (Taxus) for a Small* Container Nursery in Ohio, 1982

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	21,140.00	6,131
Soil mixture	Pine bark, sand, nutrients	cu yd	33.00	169.20	5,584
Liners	3-year 6-7" liner	each	1.25	21,140.00	26,425
Polyethylene film	4 mil white, 32 x 225'	each	107.00	10.20	1,091
Strip tags	5/8" x 7" plastic strip tag	each	.02	20,085.00	402
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Metra-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Velthane) (miticide)	pound	22.25	[illegible]	[illegible]
	Chlorothalonil 1UM cu rt (Termil) (fungicide)	canister	1.30	60.20	114
	Lesco 3-4 mo (20-6-12)+Fe	pound	.80	5,707.80	4,566
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (Roundup) (herbicide)	quart	16.60	2.80	47
Subtotal					45,695
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15**	1,673.00	8,616
	Related labor hours	hour	5.15	335.00	1,725
Subtotal					10,341
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	58,996.00	4,425
Total Annual Variable Costs					63,536
Annual Variable Cost per 12-15 Inch Salable Plant					3.16

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Slow Growing Evergreens, 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 20,085 12-15 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 2.--Annual Variable Costs (Dollars) for Slow Growing Evergreens (Taxus) for a Large* Container Nursery in Ohio, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	42,280.00	12,261
Soil mixture	Pine bark, sand, nutrients	cu yd	33.00	338.40	11,168
Liners	3-year 6-7" liner	each	1.25	42,280.00	52,850
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Strip tags	5/8" x 7" plastic strip tag	each	.02	40,165.00	803
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Lesco 3-4 mo (20-6-12)	pound	.80	11,415.60	9,132
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (Roundup) (herbicide)	quart	16.60	5.60	93
Subtotal					90,185
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15**	3,346.00	17,231
	Related labor hours	hour	5.15	669.00	3,445
Subtotal					20,676
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	117,009.00	8,776
Total Annual Variable Costs					125,919
Annual Variable Cost per 12-15 Inch Salable Plant					3.14

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Slow Growing Evergreens, 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 40,165 12-15 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

Table 3.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) of Producing Slow Growing Evergreens (Taxus) in Containers in Ohio, 1982.

Item	Small Container Nursery*			Large Container Nursery**		
	Cost	Cost per Salable Plant	Percent of Total Cost	Cost	Cost per Salable Plant	Percent of Total Cost
Fixed Cost Items						
Land and Improvements	8,616	.43	8	16,436	.41	8
Buildings	10,190	.51	9	16,127	.40	8
Machinery and Equipment	9,129	.45	8	13,142	.33	6
General Overhead	19,005	.95	17	30,000	.75	15
Interest on General Overhead, Insurance, and Taxes	1,577	.08	1	2,504	.06	1
Subtotal	48,517	2.42	43	78,209	1.95	38
Variable Cost Items						
Materials	45,095	2.24	40	90,185	2.24	44
Machinery and Equipment	3,675	.18	3	6,282	.16	3
Labor	10,341	.52	10	20,676	.51	10
Interest on Operating Capital	4,425	.22	4	8,776	.22	5
Subtotal	63,536	3.16	57	125,919	3.13	62
Total Annual Costs	112,053	5.58	100	204,128	5.08	100

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Slow Growing Evergreens, 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 20,085 12-15 inch salable plants per year.

**Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Slow Growing Evergreens, 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 40,165 12-15 inch salable plants per year.